YAMAHA
YAMAHA MOTOR CO., LTD.

YAMAHA CARTESIAN ROBOT XY-X series

NXY

User's Manual

ENGLISH E

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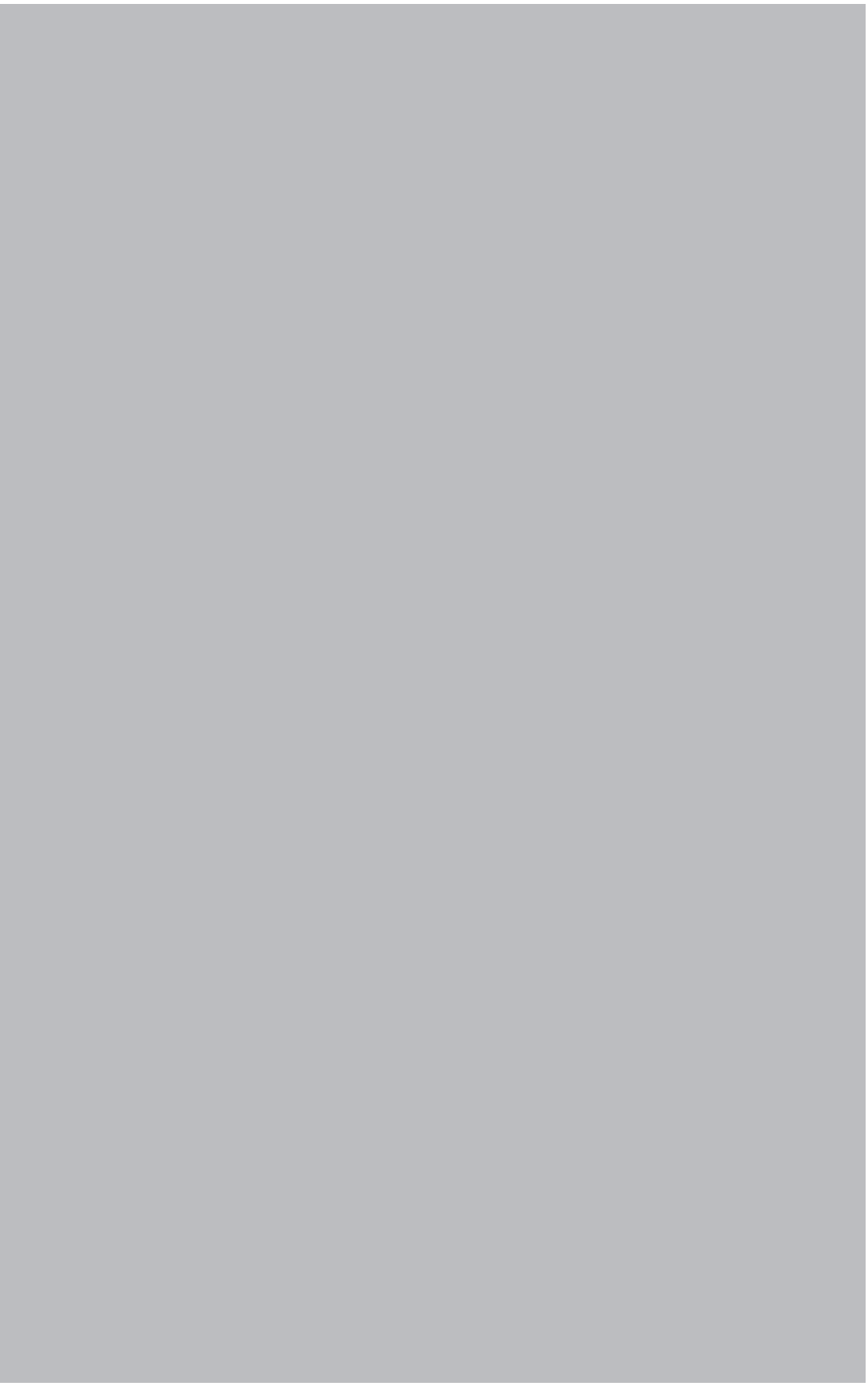


1. Safety Information

Industrial robots are highly programmable machines that provide a large degree of freedom in movement. To ensure correct and safe use of YAMAHA robots, carefully read this manual to make yourself well acquainted with the contents. FOLLOW THE WARNINGS, CAUTIONS AND INSTRUCTIONS INCLUDED IN THIS MANUAL. Failure to take necessary safety measures or mishandling due to not observing the instructions in this manual may result in trouble or damage to the robot and injury to personnel (robot installer, operator or service personnel) including fatal accidents.

Warning information in this manual is classified into the following items.

DANGER

FAILURE TO FOLLOW DANGER INSTRUCTIONS WILL RESULT IN SEVERE INJURY OR DEATH TO THE ROBOT OPERATOR, BYSTANDERS OR PERSONS SERVICING THE ROBOT.

WARNING

FAILURE TO FOLLOW WARNING INSTRUCTIONS COULD RESULT IN SEVERE INJURY OR DEATH TO THE ROBOT OPERATOR, BYSTANDERS OR PERSONS SERVICING THE ROBOT.

CAUTION

Failure to follow CAUTION instructions may result in injury to the robot operator, bystanders or persons servicing the robot, or damage to the robot and/or robot controller.

NOTE

Explains the keypoint in the operation in a simple and clear manner.

Refer to the user's manual by any of the following methods to operate or adjust the robot safely and correctly.

1. Operate or adjust the robot while referring to the printed version of the user's manual (available for an additional fee).
2. Operate or adjust the robot while viewing the CD-ROM version of the user's manual on your computer screen.
3. Operate or adjust the robot while referring to a printout of the necessary pages from the CD-ROM version of the user's manual.

It is not possible to list all safety items in detail within the limited space of this manual. Thus, it is essential that the user have full knowledge of basic safety rules and that the operator makes correct judgments on safety procedures during operation.
When exporting this robot, the warning labels and user's manuals must be changed to export specifications.

2. Essential Caution Items

Particularly important cautions for handling or operating the robot are described below. In addition, safety information about installation, operation, inspection and maintenance is provided in each chapter. Be sure to comply with these instructions to ensure safe use of the robot.

(1) Observe the following cautions during automatic operation

DANGER

SERIOUS INJURY WILL RESULT FROM IMPACT WITH MOVING ROBOT.
- **KEEP OUTSIDE SAFEGUARD ENCLOSURE DURING AUTOMATIC OPERATION.**
- **PRESS THE EMERGENCY STOP BUTTON BEFORE ENTERING THE SAFEGUARD ENCLOSURE.**

The warning label 1 is attached to the robot.

- Install a safeguard enclosure to keep all personnel from entering within the movable range of the robot and suffering injury due to being struck by moving parts.
- Install a safety interlock that triggers emergency stop when the door or panel is opened.
- Install safeguards so that no one can enter inside except from doors or panels equipped with safety interlocks.
- The warning label 1 are supplied with the robot and should be affixed to conspicuous places on doors or panels equipped with safety interlocks.

DANGER
Serious injury or death will result from impact with moving robot.
• Keep outside of guard during operation.
• Lock out power before approaching robot.

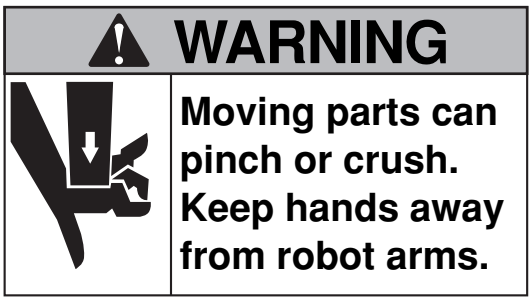
Warning label 1

(2) Use caution to prevent hands or fingers from being pinched or crushed.

WARNING

MOVING PARTS CAN PINCH OR CRUSH.
KEEP HANDS AWAY FROM ROBOT ARMS.

Warning label 2 is affixed to the robot.
Use caution to prevent hands or fingers from being pinched or crushed in the robot's moving parts during transporting the robot or teaching, etc.



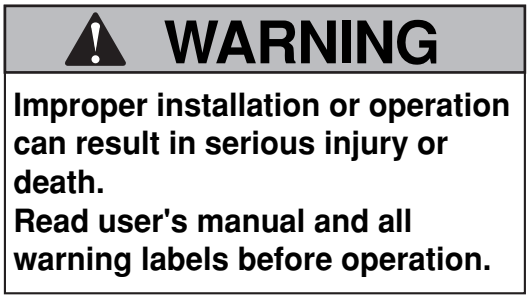
Warning label 2

(3) Follow the instructions listed on warning labels and in this manual.

WARNING
IMPROPER INSTALLATION OR OPERATION CAN RESULT IN SERIOUS INJURY. READ THE USER'S MANUAL AND ALL WARNING LABELS BEFORE OPERATION.

The warning label 3 is attached to the robot.

- Be sure to read the warning labels and this manual carefully and make sure to thoroughly understand the contents before attempting installation and operation of the robot.
- Before starting robot operation, be sure to reread the procedures and cautions related to the work as well as the descriptions in this chapter (Chapter 1. "Using the Robot Safely").
- Never install, adjust, inspect, service or operate the robot in any manner that does not comply with the instructions in this manual.


WARNING
Improper installation or operation can result in serious injury or death.
Read user's manual and all warning labels before operation.

Warning label 3

(4) Do not use the robot in environments containing inflammable gas, etc.

WARNIG
THIS ROBOT IS NOT DESIGNED FOR OPERATION IN ENVIRONMENTS WHERE INFLAMMABLE OF EXPLOSIVE SUBSTANCES ARE PRESENT.DO NOT USE THE ROBOT IN ENVIRONMENTS CONTAINING INFLAMMABLE GAS, DUST OR LIQUIDS. EXPLOSIONS OR FIRE MIGHT OTHERWISE RESULT.

(5) Do not use the robot in locations possible subject to electromagnetic interference, etc.

WARNING
AVOID USING THE ROBOT IN LOCATIONS SUBJECT TO ELECTROMAGNETIC INTERFERENCE, ELECTROSTATIC DISCHARGE OR RADIO FREQUENCY INTERFERENCE. MALFUNCTIONS MIGHT OTHERWISE OCCUR.

(6) Use caution when releasing the brake for the Z-axis (vertical axis).

WARNING
THE Z-AXIS WILL DROP WHEN THE BRAKE IS RELEASED, CREATING A HAZARDOUS SITUATION.
- PRESS THE EMERGENCY STOP BUTTON AND PROP UP THE Z-AXIS WITH A SUPPORT STAND, ETC., BEFORE RELEASING THE BRAKE.
- BE CAREFUL NOT TO LET YOUR BODY GET CAUGHT BETWEEN THE Z-AXIS AND INSTALLATION BASE, ETC., WHEN RELEASING THE BRAKE TO PERFORM DIRECT TEACHING.

(7) Provide safety measures for end effector (gripper, etc.)

WARNING
- END EFFECTORS MUST BE DESIGNED AND MANUFACTURED SO THAT THEY CREATE NO HAZARDS (FOR EXAMPLE, A WORKPIECE THAT COMES LOOSE) EVEN IF POWER (ELECTRICITY, AIR PRESSURE, ETC.) IS SHUT OFF OR A POWER FLUCTUATION OCCURS.
- IF THERE IS A POSSIBLE DANGER THAT THE OBJECT GRIPPED BY THE END EFFECTOR MAY FLY OFF OR DROP, THEN PROVIDE APPROPRIATE SAFETY PROTECTION TAKING INTO ACCOUNT THE OBJECT SIZE, WEIGHT, TEMPERATURE AND CHEMICAL PROPERTIES.

(8) Movement of Z-axis at controller power shut off and emergency stop (for ZAS)

WARNING
THE Z-AXIS WILL START TO RISE WHEN THE CONTROLLER POWER IS SHUT OFF, THE PLC POWER IS SHUT OFF, THE PROGRAM IS RESET, EMERGENCY STOP IS APPLIED, AND WHEN THE SUPPLY OF AIR TO THE Z-AXIS AIR CYLINDER'S SOLENOID VALVE IS STARTED.
- TAKE CARE NOT TO PINCH OR CRUSH HANDS, ETC., IN THE Z-AXIS MOVING SECTIONS.
- IF THERE ARE ANY INTERFERENCES IN THE Z-AXIS' UPWARD TRAVEL PATH, REEVALUATE THE ROBOT POSITION, EXCEPT FOR EMERGENCIES.

(9) Pay attention to interference of Z-axis with peripheral devices (for ZAS)

WARNING

IF THE Z-AXIS INTERFERES WITH A PERIPHERAL DEVICE AND STOPS, THERE IS A RISK OF PINCHING HANDS, ETC., WHEN THE INTERFERING OBJECT IS REMOVED AS THE Z-AXIS WILL SUDDENLY MOVE.

- **TURN THE CONTROLLER POWER OFF AND STOP THE AIR SUPPLY BEFORE REMOVING THE INTERFERING OBJECT.**
- **THE Z-AXIS WILL NATURALLY DROP, SO PROP IT UP WITH A SUPPORT STAND, ETC., BEFORE STOPPING THE AIR SUPPLY.**

(10) Z-axis movement when air supply is stopped

WARNING

THE Z-AXIS WILL DROP WHEN THE AIR SUPPLY IS STOPPED, CREATING A HAZARDOUS SITUATION. PROP UP THE Z-AXIS WITH A SUPPORT STAND, ETC., BEFORE TURNING THE CONTROLLER POWER OFF AND STOPPING THE AIR SUPPLY.

(11) Use caution when disassembling and replacing the pneumatic devices

WARNING

IF THE PNEUMATIC DEVICES ARE DISASSEMBLED OR REPLACED WHILE THE AIR IS SUPPLIED, THE PARTS OR AIR COULD SCATTER.

- **TURN THE CONTROLLER POWER OFF, STOP THE AIR SUPPLY AND RELEASE ALL RESIDUAL PRESSURE FROM THE PNEUMATIC DEVICES BEFORE STARTING WORK.**
- **THE Z-AXIS WILL NATURALLY DROP, SO PROP IT UP WITH A SUPPORT STAND, ETC., BEFORE STOPPING THE AIR SUPPLY.**

(12) Use caution when disassembling and replacing the motor

WARNING

WHEN DISASSEMBLING OR ASSEMBLING THE MOTOR FOR A BALL-SCREW DRIVE TYPE ROBOT, A STRONG MAGNETIC ATTRACTION FORCE WILL BE PRESENT BETWEEN THE MOTOR STATOR (FIXED COIL) AND ROTOR (ROTATING MAGNET), CAUSING A RISK OF PINCHING HANDS, ETC. A YAMAHA-TRAINED OPERATOR MUST CARRY OUT THIS WORK USING THE YAMAHA-RECOMMENDED JIGS.

(13) Use caution when removing the Z-axis brake

WARNING

THE Z-AXIS WILL NATURALLY DROP WHEN THE BRAKE IS REMOVED, CAUSING A HAZARDOUS SITUATION.

- **PROP UP THE Z-AXIS WITH A SUPPORT STAND, ETC., BEFORE TURNING THE CONTROL POWER OFF AND REMOVING THE BRAKE.**
- **BE CAREFUL NOT TO LET YOUR BODY GET CAUGHT BETWEEN THE Z-AXIS DRIVE SECTION AND Z-AXIS INSTALLATION BASE, ETC.**

(14) Take the following safety precautions during inspection of the controller

WARNING
- IF THE TERMINALS OR CONNECTORS ON THE OUTSIDE OF THE CONTROLLER MUST BE TOUCHED DURING INSPECTION, ETC., ALWAYS FIRST TURN THE CONTROLLER POWER OFF AND THE POWER SOURCE TO PREVENT POSSIBLE ELECTRICAL SHOCK.
- REFER TO THE "YAMAHA ROBOT CONTROLLER USER'S MANUAL" FOR PRECAUTIONS ON HANDLING THE CONTROLLER. NEVER TOUCH ANY INTERNAL PARTS OF THE CONTROLLER.

(15) Consult YAMAHA for corrective action when the robot is damaged or malfunctions occur.

WARNING
IF ANY PART OF THE ROBOT IS DAMAGED OR ANY MALFUNCTION OCCURS, CONTINUING THE OPERATION MAY BE VERY DANGEROUS. PLEASE CONSULT YOUR YAMAHA SALES OFFICE OR DEALER FOR CORRECTIVE ACTION.

Damage or Trouble	Possible Danger
Damage to machine harness or robot cable	Electrical shock, malfunction of robot
Damage to exterior of robot	Flying outward of damaged parts during robot operation
Abnormal operation of robot (positioning error, excessive vibration, etc.)	Malfunction of robot
Z-axis brake trouble	Dropping of load

(16) Use caution not to touch the controller rear panel cooling fan

WARNING
- INJURY MAY OCCUR FROM COMING INTO CONTACT WITH THE COOLING FAN WHILE IT IS ROTATING.
- WHEN REMOVING THE FAN COVER FOR INSPECTION, FIRST TURN OFF THE CONTROLLER AND MAKE SURE THAT THE FAN HAS STOPPED.

(17) Be careful not to touch the motor or speed reduction gear casing when hot.

WARNING
THE MOTOR AND SPEED REDUCTION GEAR CASING ARE EXTREMELY HOT AFTER AUTOMATIC OPERATION, SO BURNS MAY OCCUR IF THESE ARE TOUCHED.
- BEFORE HANDLING THESE PARTS DURING INSPECTION OR SERVICING, TURN THE CONTROLLER POWER OFF, WAIT FOR A WHILE AND CHECK THAT THE PART HAS COOLED.

(18) Do not remove, alter or stain the warning labels

WARNING

IF THE WARNING LABELS ARE REMOVED OR DIFFICULT TO SEE, THEN ESSENTIAL PRECAUTIONS MIGHT NOT BE TAKEN RESULTING IN ACCIDENTS.

- DO NOT REMOVE, ALTER OR STAIN THE WARNING LABELS ON THE ROBOT.
- DO NOT ALLOW THE WARNING LABELS TO BE HIDDEN BY DEVICES INSTALLED ONTO THE ROBOT BY THE USER.
- PROVIDE PROPER LIGHTING SO THAT THE SYMBOLS AND INSTRUCTIONS ON THE WARNING LABELS CAN BE CLEARLY SEEN EVEN FROM OUTSIDE THE SAFEGUARD ENCLOSURE.

(19) Protective connections

WARNING

BE SURE TO GROUND THE ROBOT AND CONTROLLER TO PREVENT ELECTRICAL SHOCK.

(20) Be sure to make correct parameter settings - Part 1

CAUTION

Always input the correct parameters matching the payload and stroke (working envelope) before operating the robot.

(21) Be sure to make correct parameter settings - Part 2

CAUTION

When using a rotary axis (RF, RH, etc.) the robot must be operated with the tolerable moment of inertia and correct acceleration coefficients according to the tip mass and moment of inertia. If these are not correct, the drive unit service life may end prematurely, and damage to robot parts or residual vibration during positioning may result.

(22) Do not use the robot for tasks requiring motor thrust.

CAUTION

Avoid using the belt-driven type robots for tasks that utilize motor thrust (press fitting, burr removal, etc.). These tasks may cause malfunctions in the robot.

3. Special Training for Industrial Robot Operation

Companies or factories using industrial robots must make sure that every person, who handles the robot such as for teaching, programming, movement check, inspection, adjustment and repair, has received appropriate training and also has the skills needed to perform the job correctly and safely. Since YAMAHA Cartesian robot XY series falls under the industrial robot category, the user must observe local regulations and safety standards for industrial robots, and provide special training for every person involved in robot-related tasks (teaching, programming, movement check, inspection, adjustment, repair, etc.).

4. Robot Safety Functions

(1) Overload detection

This function detects an overload applied to the motor and shuts off the servo power.

(2) Overheat detection

This detects an abnormal rise in the controller driver temperature and shuts off the servo power.

If an overload or overheat error occurs, take the following measuring.

① Insert a timer in the program.

② Reduce the acceleration coefficient.

(3) Soft limits

Soft limits can be set on each axis to limit the working envelope in manual operation after return-to-origin and during automatic operation. Note that the working envelope is the area limited by soft limits.

(4) Mechanical stoppers

If the servo power is suddenly shut off during high-speed operation by emergency stop or safety functions, these mechanical stoppers prevent the axis from exceeding the movable range. Note that the movable range is the area limited by the mechanical stoppers. No mechanical stopper is provided on the R-axis.

(5) Z-axis (vertical axis) brake

An electromagnetic brake is installed on the Z-axis to prevent the Z-axis from dropping when the servo power is shut off. This brake is working when the controller power is OFF or if the Z-axis servo is OFF even when the controller power is ON. The Z-axis brake can be released by means of the programming unit or by a command in the program when the controller power is ON.

WARNING

THE Z-AXIS WILL DROP WHEN THE BRAKES ARE RELEASED, CREATING A HAZARDOUS SITUATION.

- **PRESS THE EMERGENCY STOP BUTTON AND PROP UP THE Z-AXIS WITH A SUPPORT STAND, ETC., BEFORE RELEASING THE BRAKE.**
- **BE CAREFUL NOT TO LET YOUR BODY GET CAUGHT BETWEEN THE Z-AXIS AND INSTALLATION BASE, ETC., WHEN RELEASING THE BRAKE TO PERFORM DIRECT TEACHING.**

5. Safety Measures for the System

When the robot is commonly used in conjunction with an automated system, dangerous situations are more likely to occur from the automated system than from the robot itself. Appropriate safety measures must be taken on the part of the system manufacturer according to the individual system. The system manufacture should provide a proper user's manual for safe, correct operation and servicing of the system.

6. Trial Run

After making installations, adjustments, inspections, maintenance or repairs to the robot, carry out trial run using the following procedures.

(1) If a safeguard enclosure has not yet been provided right after installation of the robot, rope off or chain off the movable range in place of the safeguard enclosure, and observe the following points.

① Use sturdy, stable posts that will not fall over easily.

② The rope or chain should be easily visible by everyone around the robot.

③ Place a sign to keep the operator or other personnel from entering the movable range.

(2) Check the following points before turning the controller ON.

① Is the robot securely and correctly installed?

② Are the electrical connections to the robot correct?

③ Are items such as air pressure correctly supplied?

④ Is the robot correctly connected to peripheral devices?

⑤ Have safety measures (safeguard enclosure, etc.) been taken?

⑥ Does the installation environment meet the specified standards?

(3) After the controller power is turned ON, check the following points from outside the safeguard enclosure.

① Does the robot start and stop as intended? Can the operation mode be selected correctly?

② Does each axis move as intended within the soft limits?

③ Does the end effector move as intended?

④ Are the signal transmissions to the end effector and peripheral devices correct?

⑤ Does emergency stop work?

⑥ Are the teaching and playback functions normal?

⑦ Are the safeguard enclosure and interlock working as intended?

⑧ Does the robot move correctly during automatic operation?

7. Work Within the Safeguard Enclosure

When work is required in the safeguard enclosure, always turn the controller power OFF and place a sign indicating that the robot is being adjusted or serviced in order to keep any other personnel from touching the controller power switch or operation panel, except for the time during soft limit setting and teaching operation. Follow the applicable parts of cautions and procedures in the user's manual for soft limit setting. Read the below for teaching operation.

■ Teaching operation within a safety enclosure

(1) Check or perform the following points from outside the safeguard enclosure.

① Make sure that no hazards are present within the safeguard enclosure by a visual check.

② Check that the programming unit MPB or RPB operates correctly.

③ Check that no failures are found in the robot.

④ Check that emergency stop works correctly.

⑤ Select teaching mode and prohibit automatic operation.

(2) Never enter the movable range of the robot while within the safeguard enclosure.

8. Automatic Operation

(1) Check the following before starting automatic operation.

① No one is within the safeguard enclosure.

② The programming unit or tools, etc., are in their specified location.

③ The alarm or error lamps, etc., on the robot and peripheral devices do not flash.

④ The safeguard enclosure is securely installed with safety interlocks, etc., actuated.

(2) Observe the following during automatic operation or in cases where an error occurs.

1) After automatic operation has started, check the operation status and warning lamps to ensure that the robot is in automatic operation.

2) Never enter the safeguard enclosure during automatic operation.

3) If an error occurs in the robot or peripheral devices, observe the following procedures before entering the safeguard enclosure.

① Press the emergency stop button to set the robot to emergency stop.

② Place a sign on the start switch indicating that the robot is being inspected in order to keep any other person from touching the start switch and restarting the robot.

9. Adjustment and Inspection

WARNING

DO NOT ATTEMPT ANY INSTALLATION, ADJUSTMENT, INSPECTION OR MAINTENANCE UNLESS DESCRIBED IN THIS MANUAL. UNEXPECTED ACCIDENTS OR TROUBLES MAY OTHERWISE RESULT.

10. Repair and Modification

WARNING

DO NOT ATTEMPT ANY REPAIR, PART REPLACEMENT OR MODIFICATION UNLESS DESCRIBED IN THIS MANUAL. THESE MATTERS REQUIRE TECHNICAL KNOWLEDGE AND SKILLS, AND MAY ALSO INVOLVE WORK HAZARDS.

11. Warranty

For information on the warranty period and terms, please contact our distributor where you purchased the product.

■ **This warranty does not cover any failure caused by:**

1. Installation, wiring, connection to other control devices, operating methods, inspection or maintenance that does not comply with industry standards or instructions specified in the YAMAHA manual;
2. Usage that exceeded the specifications or standard performance shown in the YAMAHA manual;
3. Product usage other than intended by YAMAHA;
4. Storage, operating conditions and utilities that are outside the range specified in the manual;
5. Damage due to improper shipping or shipping methods;
6. Accident or collision damage;
7. Installation of other than genuine YAMAHA parts and/or accessories;
8. Modification to original parts or modifications not conforming to standard specifications designated by YAMAHA, including customizing performed by YAMAHA in compliance with distributor or customer requests;
9. Pollution, salt damage, condensation;
10. Fires or natural disasters such as earthquakes, tsunamis, lightning strikes, wind and flood damage, etc;
11. Breakdown due to causes other than the above that are not the fault or responsibility of YAMAHA;

■ **The following cases are not covered under the warranty:**

1. Products whose serial number or production date (month & year) cannot be verified.
2. Changes in software or internal data such as programs or points that were created or changed by the customer.
3. Products whose trouble cannot be reproduced or identified by YAMAHA.
4. Products utilized, for example, in radiological equipment, biological test equipment applications or for other purposes whose warranty repairs are judged as hazardous by YAMAHA.

THE WARRANTY STATED HEREIN PROVIDED BY YAMAHA ONLY COVERS DEFECTS IN PRODUCTS AND PARTS SOLD BY YAMAHA TO DISTRIBUTORS UNDER THIS AGREEMENT. ANY AND ALL OTHER WARRANTIES OR LIABILITIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY EXPRESSLY DISCLAIMED BY YAMAHA. MOREOVER, YAMAHA SHALL NOT BE HELD RESPONSIBLE FOR CONSEQUENT OR INDIRECT DAMAGES IN ANY MANNER RELATING TO THE PRODUCT.

12. CE Marking

Refer to the following YAMAHA robot controller user's manuals for details on the related CE Marking for export to or use in EU regions.

- CE marking supplement manual for RCX series

Chapter 2 INSTALLATION

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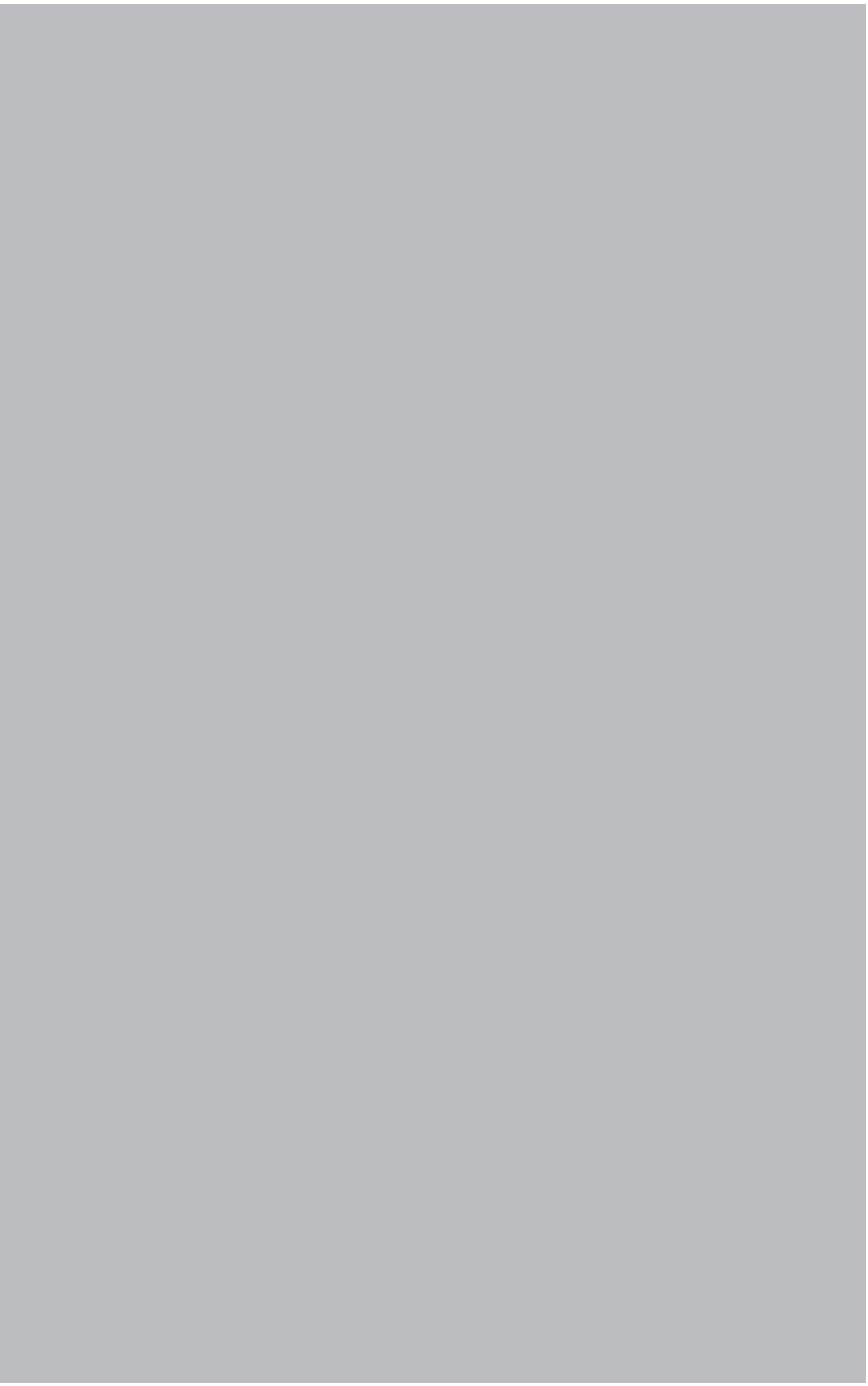


WARNING

Always turn the controller power OFF before installing the robot. Serious accidents might occur if the robot starts to operate during installation.

The NXY is installed with one of the following two methods.

Method A : Open through holes on the installation base and install with M6 bolts from below.
(M6 tap holes are opened on the bottom of the robot.)

Method B : Tap holes into the installation base and secure the robot with M6 bolts from the inside of the robot.

1. Installation bolt types

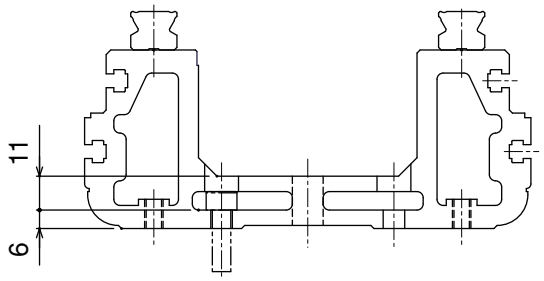
Use the installation bolt with a hexagon socket head cap screw/ M6/ strength 8.8T.

2. Installation bolt nominal length

CAUTION

Do not use washers or spring washers with the tightening bolt.
The bolt head could interfere with the linear guide's bearings and be damaged.

- When using method A, determine the nominal length so that the length of the screw from the robot bottom is 9mm or more, 27mm or less. (Refer to the drawing below.)
- When using method B, if the installation base is made of steel, secure 1D or more (6mm or more for M6) for the installation base's screw fitting length. When made of aluminum, secure 1.5D or more (9mm or more for M6). (Refer to the drawing below.)



Nominal length of the bolt

3. Tightening torque

The accurate tightening torque will differ according to the seating face frictional coefficient and the female screw material, etc. The recommended tightening torque is between 9.8N·m to 12.7N·m (100kgf·cm to 130kgf·cm).

4. Installation methods

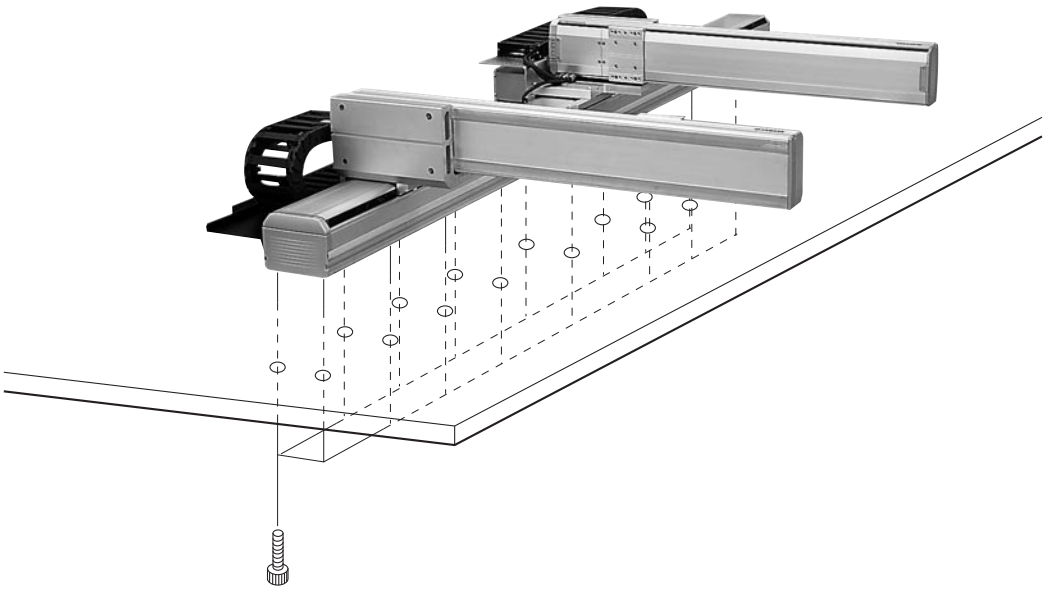
WARNING

ALWAYS USE THE DESIGNATED BOLT, AND SECURELY TIGHTEN IT WITH THE CORRECT TORQUE. FAILURE TO OBSERVE THIS COULD CAUSE THE ROBOT POSITION TO DEVIATE, AND COULD ALSO LEAD TO SERIOUS ACCIDENTS.

■ Method A

1) Open a ϕ6.5 through hole on the installation base's robot installation surface. For machining positions, refer to the external view and dimensions in the catalog or website (www.yamaha-motor.co.jp/global/industrial/robot).

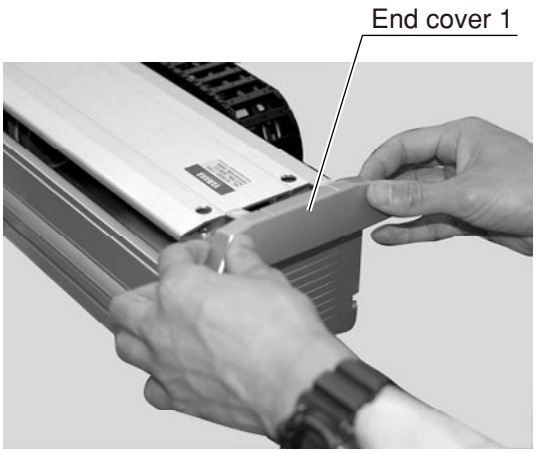
2) Set the robot on the installation base and fix with M6 bolts from below.

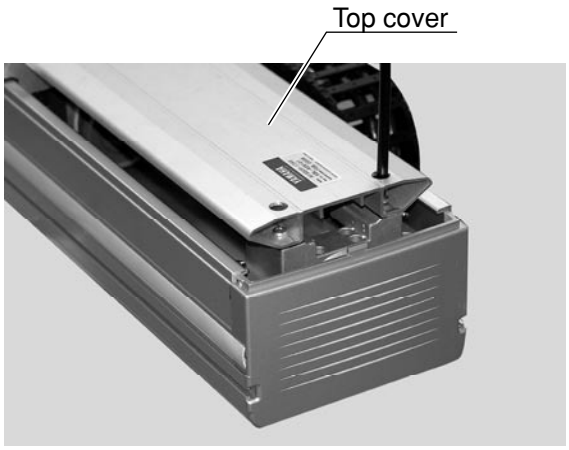


■ Method B

1) Tap M6 coarse screw thread holes into the installation base where the robot is to be installed. For machining positions, refer to the external view and dimensions in the catalog or website (www.yamaha-motor.co.jp/global/industrial/robot).

2) Remove the end cover 1 (upper end cover) from each end of the robot. Then remove the screws (4 pcs) holding the top cover and remove the top cover.





3) Secure the robot to the base with the specified bolts utilizing the mounting holes in the bottom of the robot frame. While moving the table slider, secure the robot to the base using all the mounting holes in the bottom of the robot frame.

WARNING

TIGHTEN THE BOLTS SECURELY TO THE CORRECT TORQUE. FAILURE TO FOLLOW THIS INSTRUCTION MAY CAUSE POSITIONING ERRORS AND SERIOUS ACCIDENTS.

4) After installing the robot, reattach the top cover and end covers 1 (upper end covers).

CAUTION

Take care not to catch the wiring when assembling the stroke cover.

MEMO

Chapter 3 PROTECTIVE CONNECTIONS

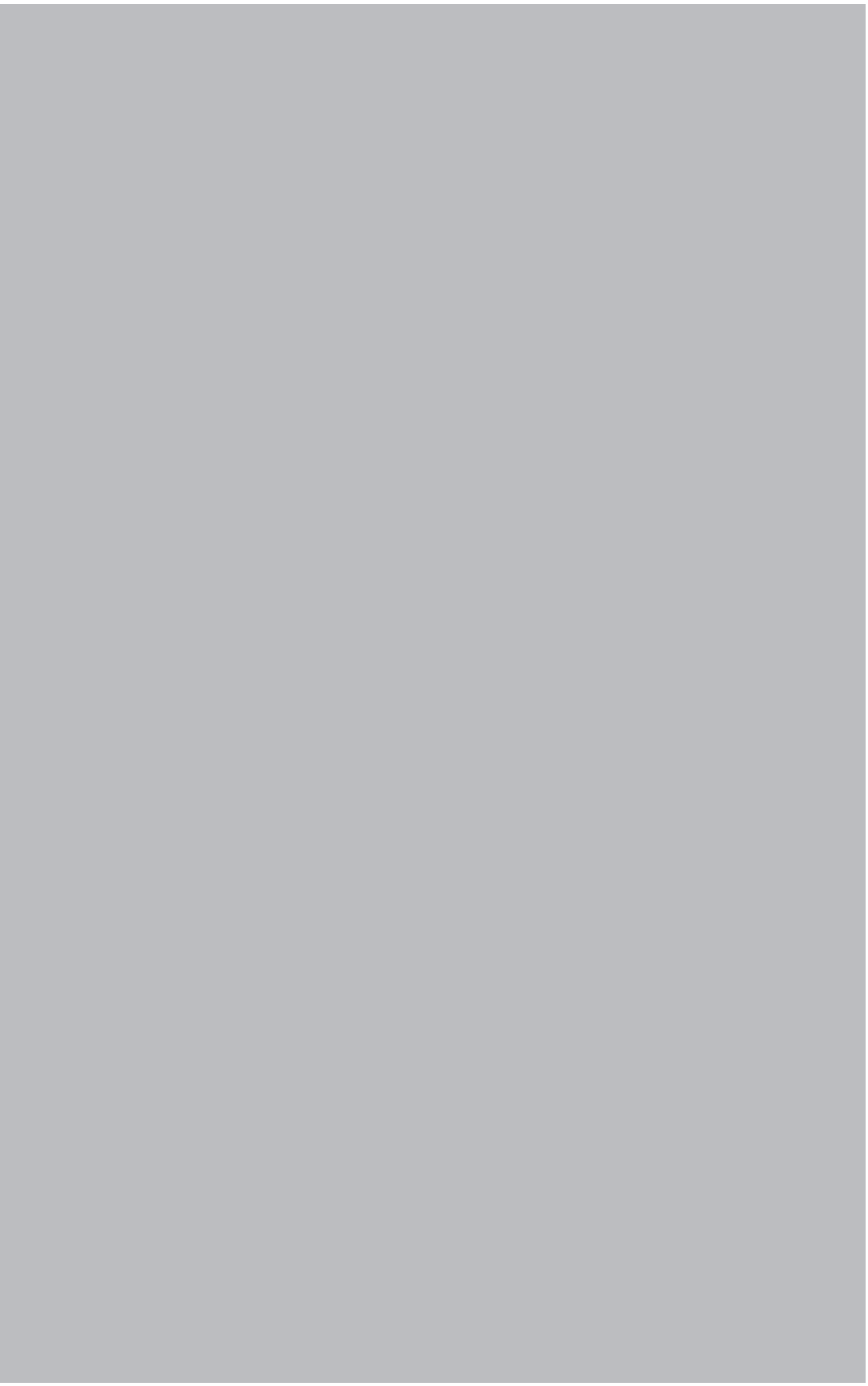
Contents

1. Ground terminal 3-1

2. Ground wire 3-2

3. Wiring methods 3-2

3-1 Grounding to the single arm robot 3-2
3-2 Grounding to the double arm robot 3-3



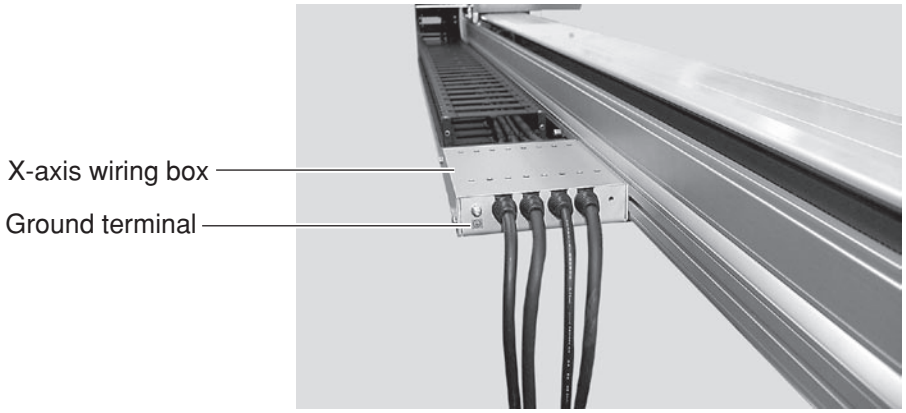
Connect the robot side ground terminal with the external protective conductor's ground terminal using a ground wire.

WARNING
- **ALWAYS GROUND THE ROBOT AND CONTROLLER TO PREVENT ELECTRICAL SHOCKS.**
- **ALWAYS TURN THE CONTROLLER POWER OFF BEFORE CONNECTING THE GROUND TO PREVENT ELECTRICAL SHOCKS.**
- **WHEN USING A TOOL OR WORKPIECE HAVING POWER WHICH COULD CONTACT THE ROBOT DUE TO A FAILURE OR THE SPECIFICATIONS, THE USER MUST PROVIDE PROPER GROUNDING SINCE THE ROBOT DOES NOT HAVE A GROUND TERMINAL FOR THOSE DEVICES.**

1. Ground terminal

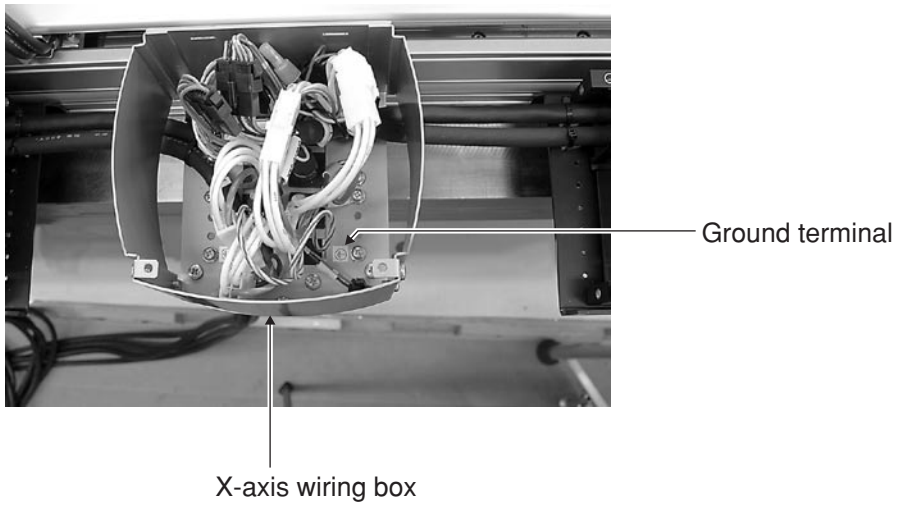
■ Single arm robot

Grounding terminal is on the external face of the X-axis wiring box.



■ Double arm robot

Grounding terminal is inside the X-axis wiring box.

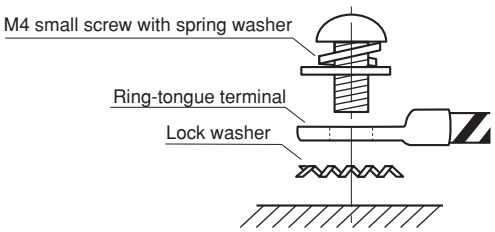


2. Ground wire

Use an AWG14 (2.0mm^2) or larger ground wire with a total length of 1m or less.
Crimp an M4 ring-tongue terminal on the end of the wire connected to the robot.

3. Wiring methods

An M4 small screw with spring washer and lock washer are attached to the ground terminal. Arrange the parts in the order of the lock washer, ring-tongue terminal and M4 small screw with spring washer, and then tighten.

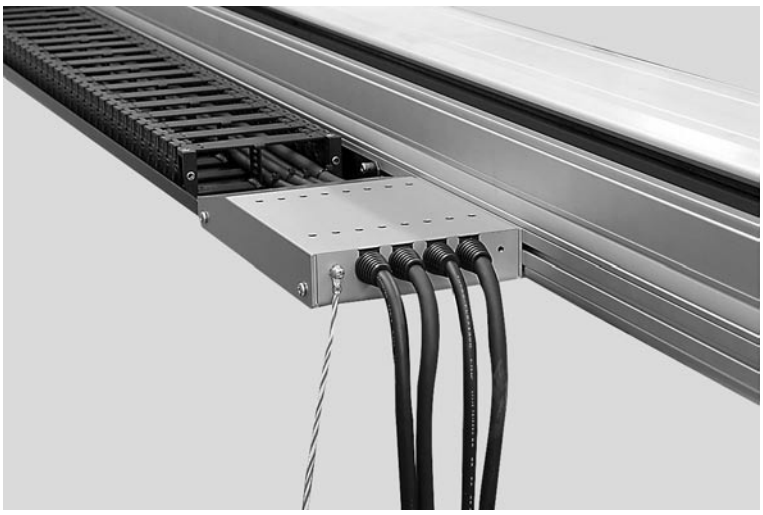


CAUTION

- **Accurately insert the lock washer between the ring-tongue terminal and robot. Proper continuity may not be secured if the lock washer is dislocated.**
- **Take care not to catch the harness and ground wire from the X-axis with the cover of X-axis wiring box when installing the cover.**

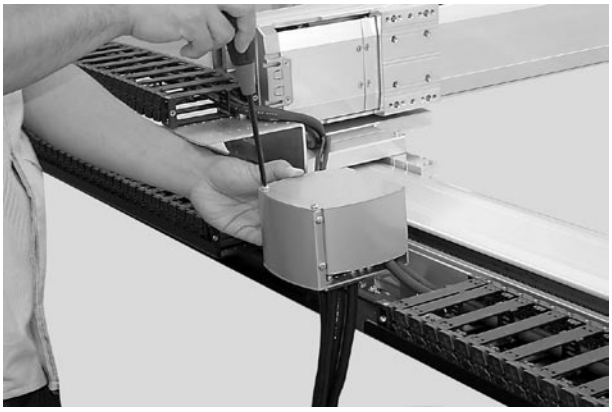
3-1 Grounding to the single arm robot

Connect the ground wire to the ground terminal on the external face of X-axis wiring box.

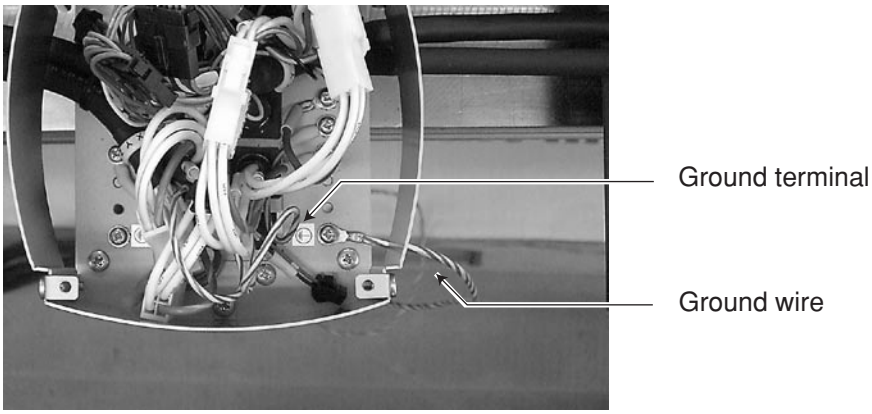


3-2 Grounding to the double arm robot

1) Remove the M4 bolts (2 pcs) on the top of the X-wiring box, and open the cover by sliding toward the robot.



2) Connect the ground wire to the ground terminal attached in the X-axis wiring box.



MEMO

Chapter 4 INSTALLING THE TOOL

Contents

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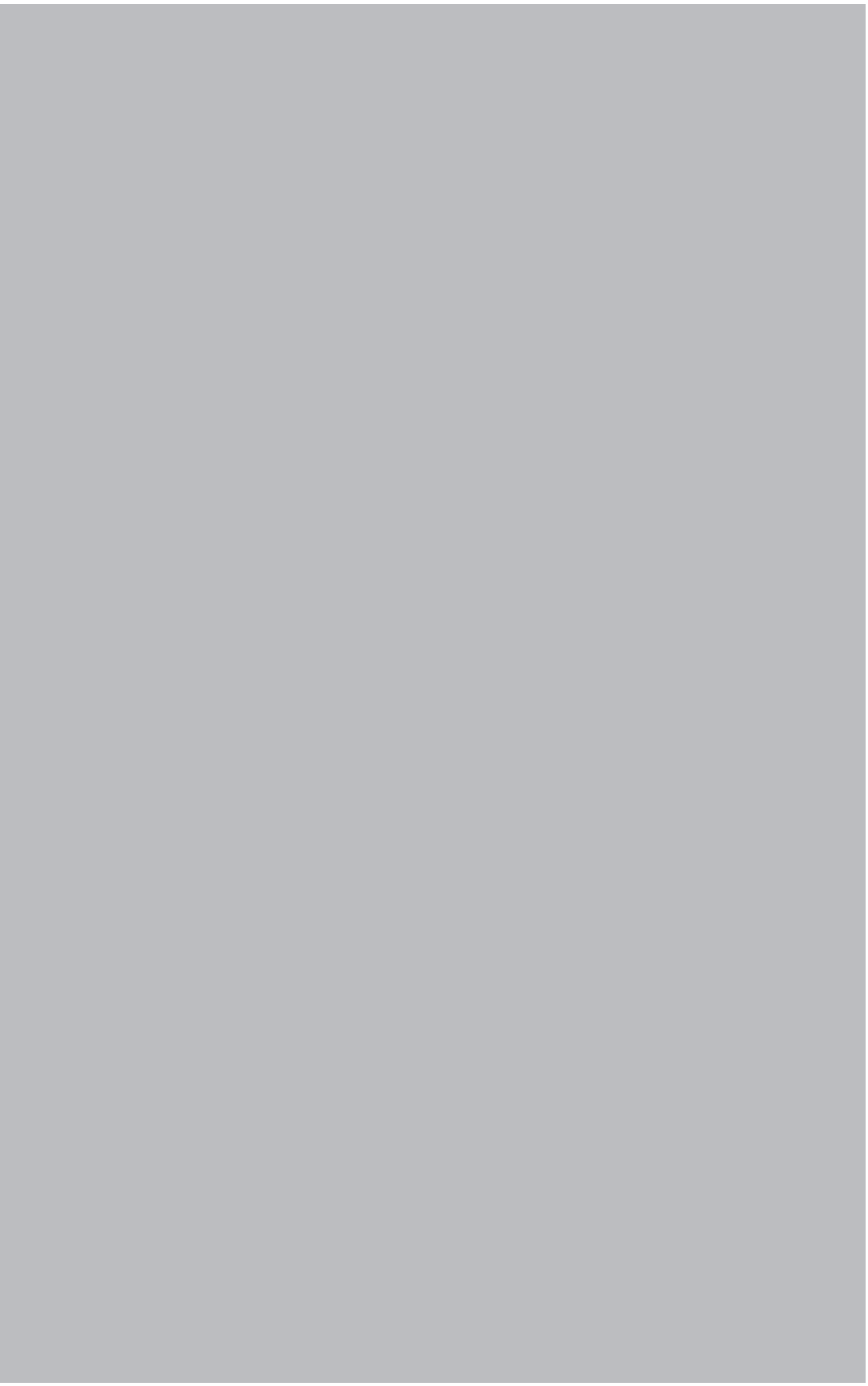
2. ZFH (single arm type, double arm type) 4-2
3. ZFL (single arm type, double arm type) 4-3

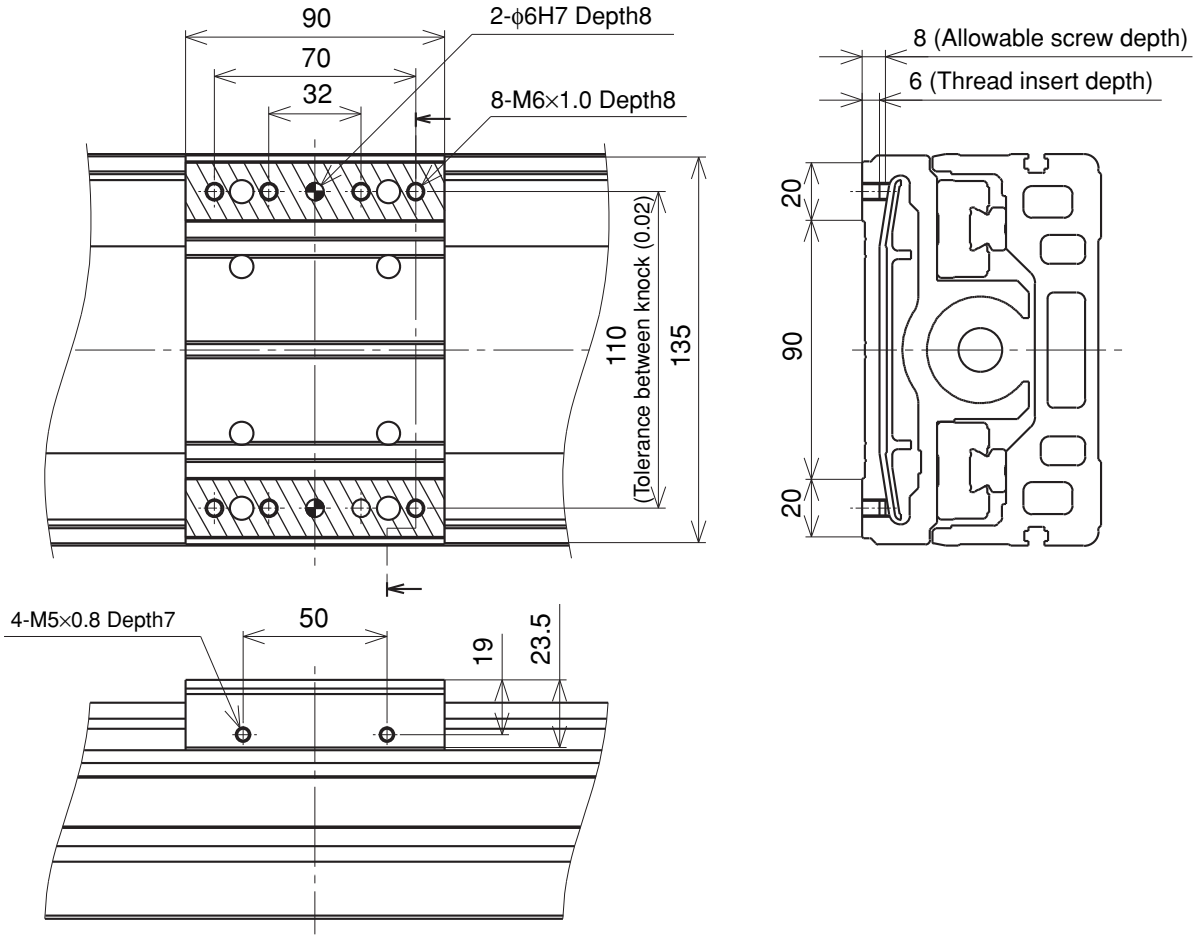


WARNING

- **ALWAYS TURN THE CONTROLLER POWER OFF BEFORE INSTALLING A TOOL TO PREVENT AN ACCIDENT.**
- **BEFORE INSTALLING A TOOL, CHECK THAT THE ROBOT IS SECURELY FIXED TO THE BASE.**
- **THE USER IS RESPONSIBLE FOR DETERMINING THE REQUIRED BOLT TYPE AND TIGHTENING TORQUE, AND ACCURATELY INSTALLING THE TOOL. IMPROPER INSTALLATION CAN CAUSE THE TOOL TO DISLOCATE DURING OPERATION AND LEAD TO SERIOUS ACCIDENTS.**

1. Single arm type, double arm type, 2-axis model

Eight M6 coarse thread tap holes and two ϕ6 reamer holes are opened on the Y-axis slider. Install the user tool onto the Y-axis slider using these holes.
M5 coarse thread tap holes are also opened on the slider side. Use these to fix light loads other than the tool, such as a wiring retainer. There is a step on the top of the slider. The actual tool installation surface is the shaded section shown in the drawing. Select the nominal length of the tool-fixing bolt so that the fitting length of the screw fixing the tool is 6mm or more, 8mm or less.

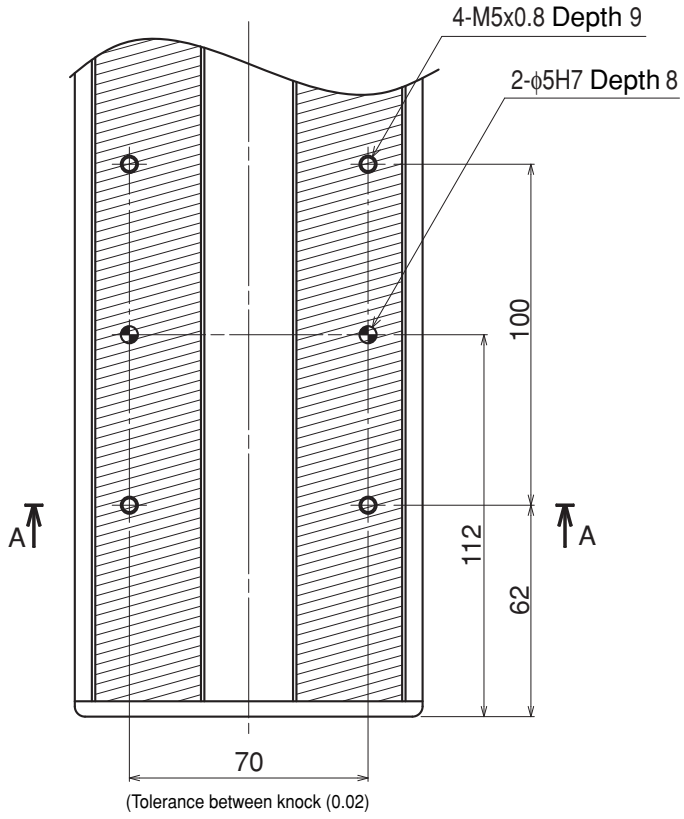


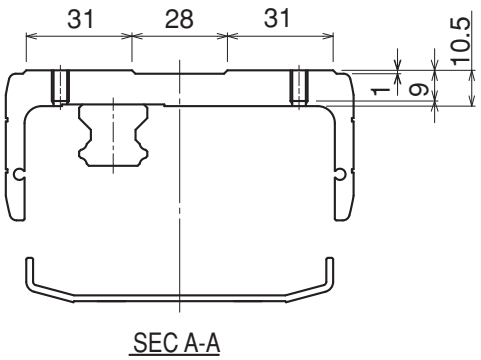
CAUTION

If the fitting length is less than 6mm, the threads could be damaged during tightening. If the fitting length exceeds 8mm, the bolt end could contact the bottom.

2. ZFH (single arm type, double arm type)

When using the 3rd-axis model with ZFH for the 3rd-axis, install the workpiece onto the ZFH slider by using four M5 coarse thread tap holes and a ϕ5 reamer hole opened on the slider's workpiece installation surface. The tap depth is 9mm. There is a step on the top of the slider. The actual tool installation surface is the shaded section shown in the drawing.



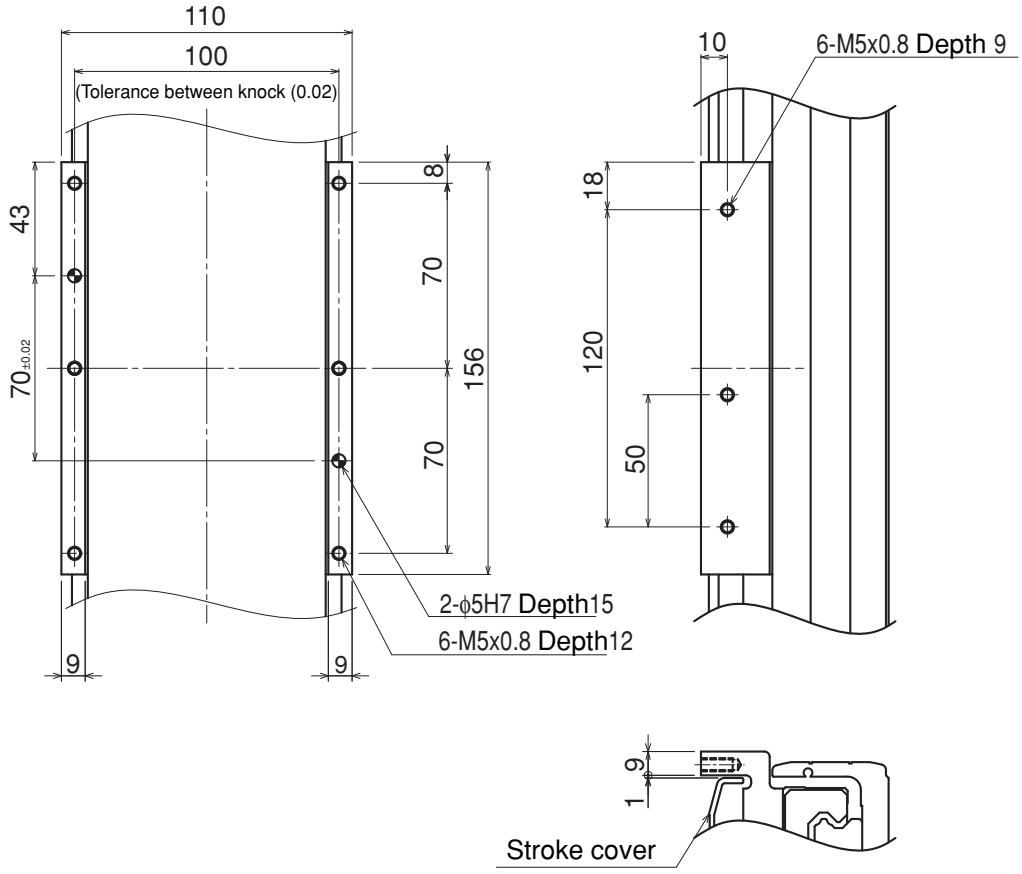


CAUTION

If the bolt fitting length is 9mm or more from the installation surface, the bolt will contact the bottom.

3. ZFL (single arm type, double arm type)

When using the 3rd-axis model with ZFL for the 3rd-axis, install the workpiece onto the ZFL slider by using six M5 coarse thread tap holes and a ϕ5 reamer hole opened on the slider's workpiece installation surface. Use six M5 coarse thread tap holes on the side of slider to fix light loads other than the tool, such as a wiring retainer. There is a step on the top of the slider. Select the nominal length of the tool-fixing bolt so that the fitting length of the screw fixing the tool is 8mm or more, 12mm or less.



CAUTION

If the bolt fitting length is 12mm or more from the installation surface, the bolt will contact the bottom.

MEMO

Chapter 5 USER WIRING AND USER PIPING

Contents

1. Cable carrier type 5-1

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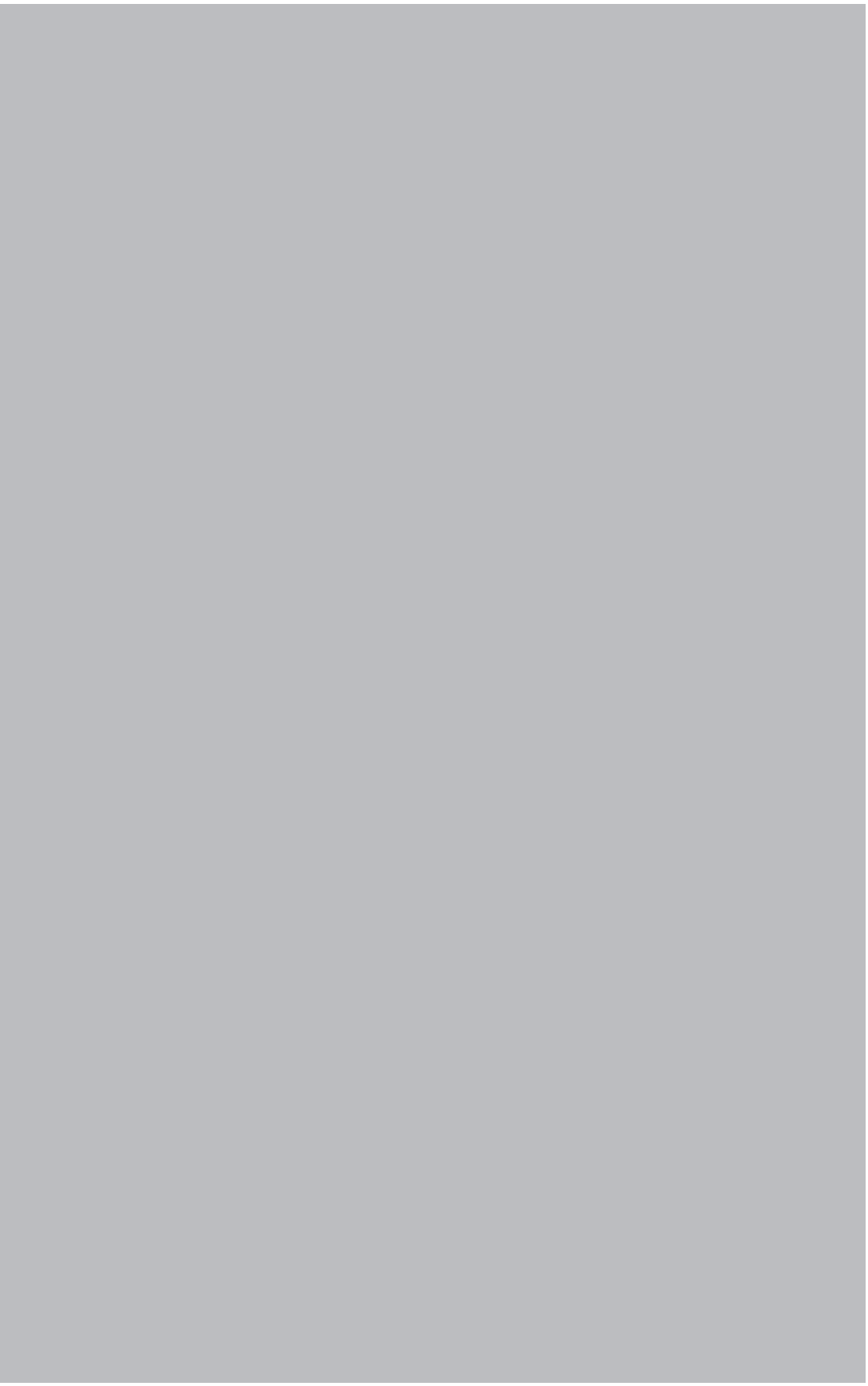


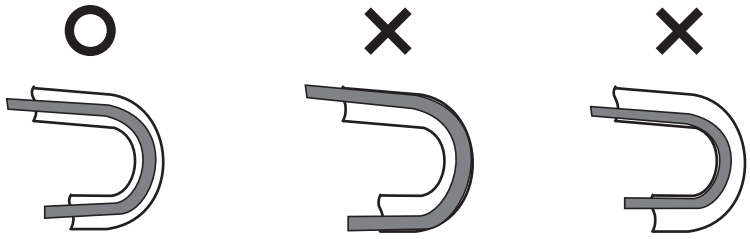
WARNING
ALWAYS TURN OFF THE CONTROLLER BEFORE WIRING AND PIPING TO PREVENT ELECTRICAL SHOCKS.

1. Cable carrier type

A cable carrier is mounted as a standard between the X and Y axes. When 3rd-axis are used, a cable carrier is also provided between the Y and Z axes, and when using 4th-axis, a cable carrier is also provided between the Z and R axes. Lay the wiring and piping to the tool using these ducts. A 0.3sq 10-core flexible cable is wired from the X-axis wiring box to the final axis' wiring box, and can be used freely. The wiring and piping methods for a 2-axis arm type are explained below as an example.

1-1 Wiring/piping to the single arm robot

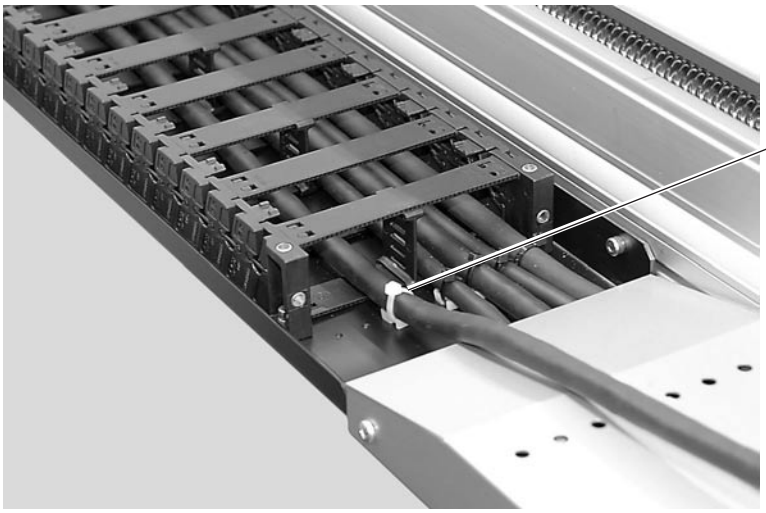
CAUTION
- **Wiring layout must be designed in the unoccupied area.**
- **Secure the wiring and piping so that they can move freely within their bending radius range.**
- **Make sure that the wiring has an adequate space, that is, about one finger as a guide when the axis moves. (See the figure below.)**

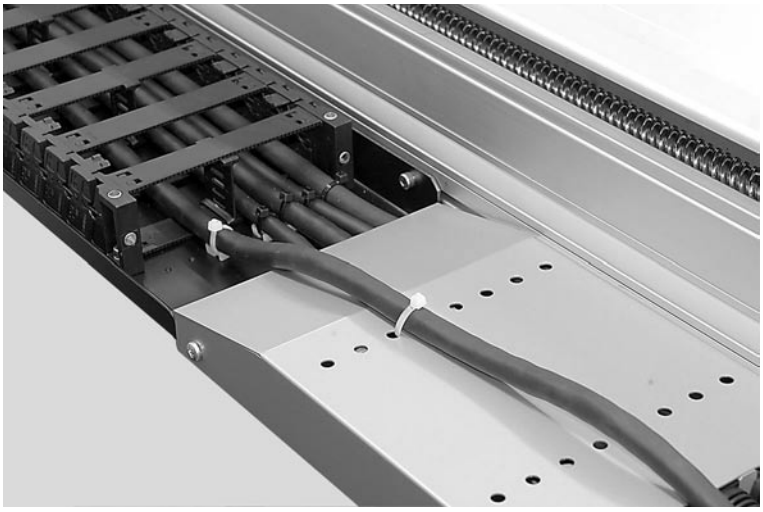


1) Remove the outer lids on the cable carrier by using a flat-tip screwdriver. The outer lids do not have to be removed if the connectors are not attached to the wiring materials.

2) Set the outer lids back in the original position after finishing the wiring layout.

3) Fix the wiring materials with Insulock ties as necessary (Insulock base must be attached). See the photograph below for the machining position.





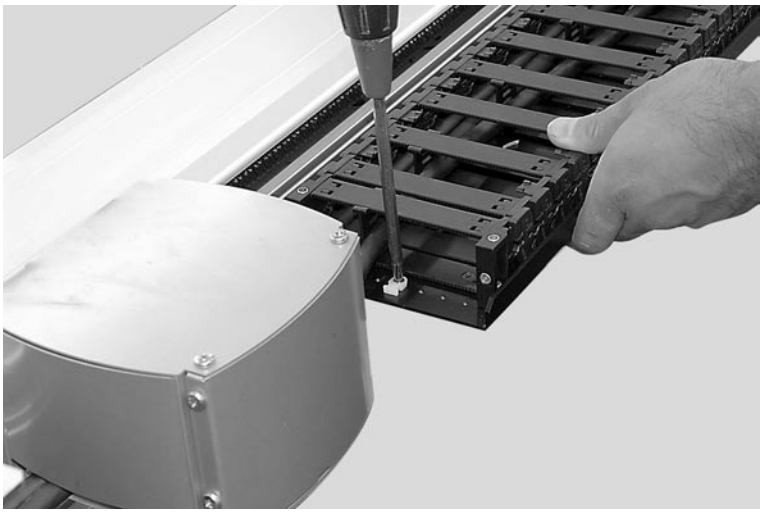
1-2 Wiring/piping to the double arm robot

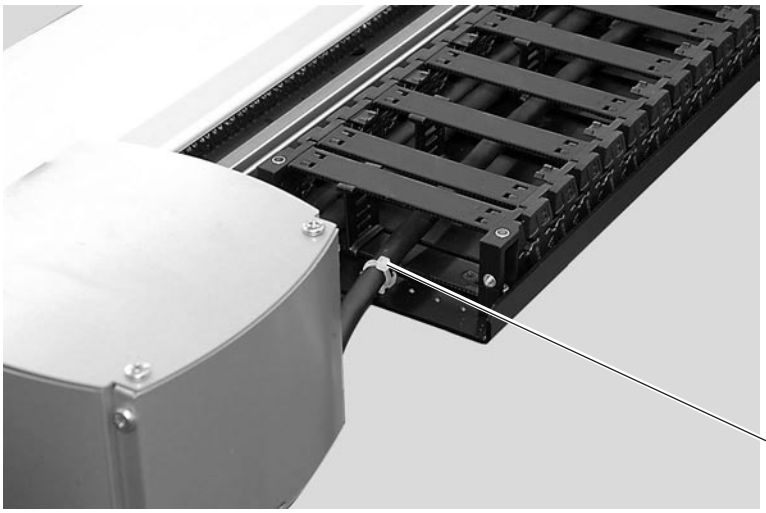
CAUTION
Wiring layout must be designed in the unoccupied area.

1) Remove the outer lids on the cable carrier by using a flat-tip screwdriver. The outer lids do not have to be removed if the connectors are not attached to the wiring materials.

2) Set the outer lids back in the original position after finishing the wiring layout.

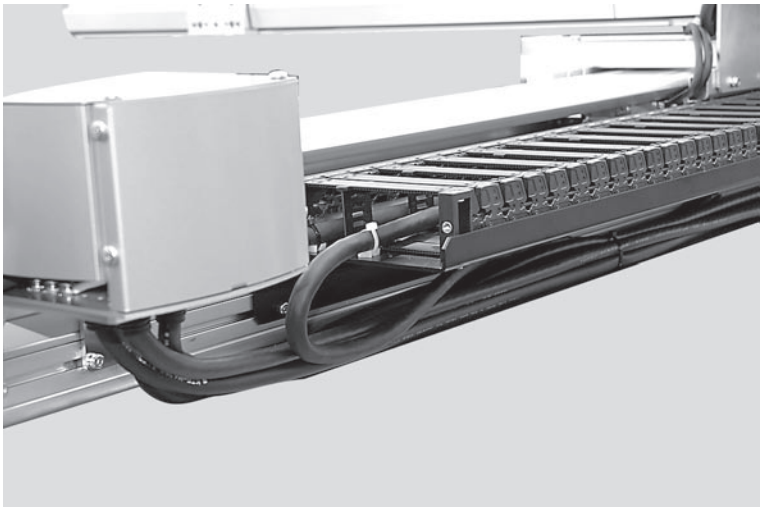
3) Fix the wiring materials with Insulock ties as necessary (Insulock base must be attached). See the photograph below for the machining position.

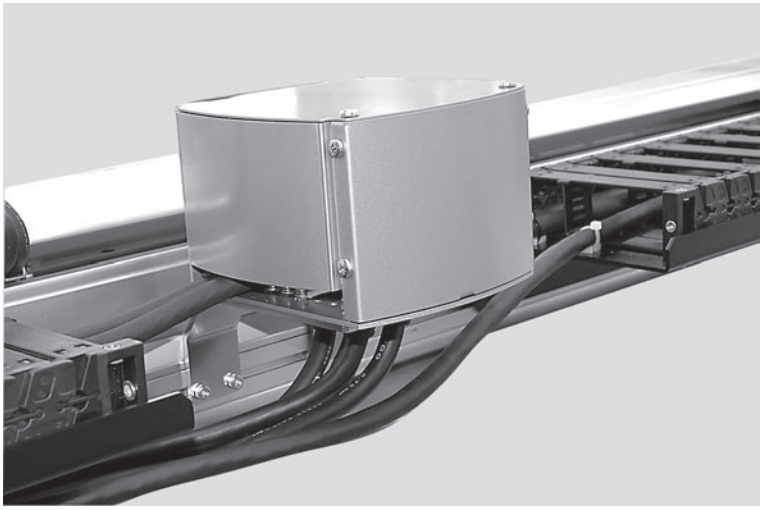




Make sure that the clamp part does not move by the wiring tension during axis operation.

4) A bundle of wires can be set either left or right of the robot.

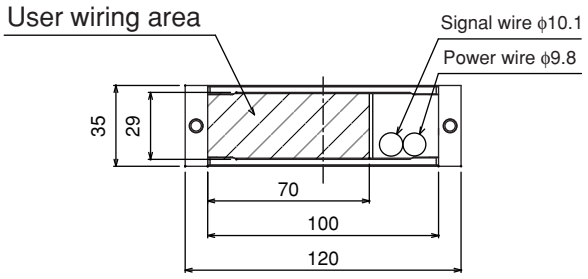




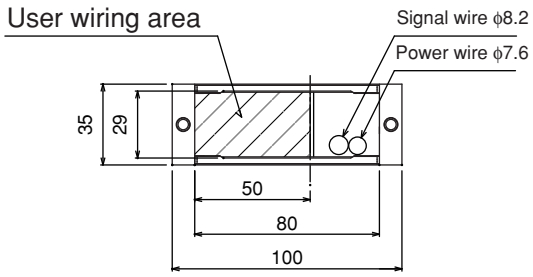
1-3 Cable carrier specifications

The cross-sectional shape of the cable carrier, and the shape of the cable mounted initially by YAMAHA are shown below.

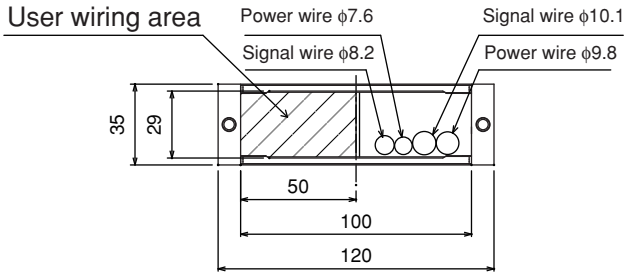
2-axis specifications X-Y cable carrier



Y-Z cable carrier



3-axis specifications X-Y cable carrier



CAUTION

- **Harness and air tube must be laid in the unoccupied area. Do not set the user wiring/piping in the YAMAHA robot cable domain.**
- **When setting the harness and air tube into the cable carrier, make sure that the total cross-sectional area of all wires and pipes, including the YAMAHA cable, inside the cable carrier does not exceed 30% of the cable carrier's cross-sectional area.**
- **When many harnesses and air tubes with different diameters and materials are stored into the cable carrier, they may intertwine with each other in spiral form, causing faulty wiring.**

Chapter 6 PERIODIC INSPECTIONS

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2. Periodic inspection 6-3

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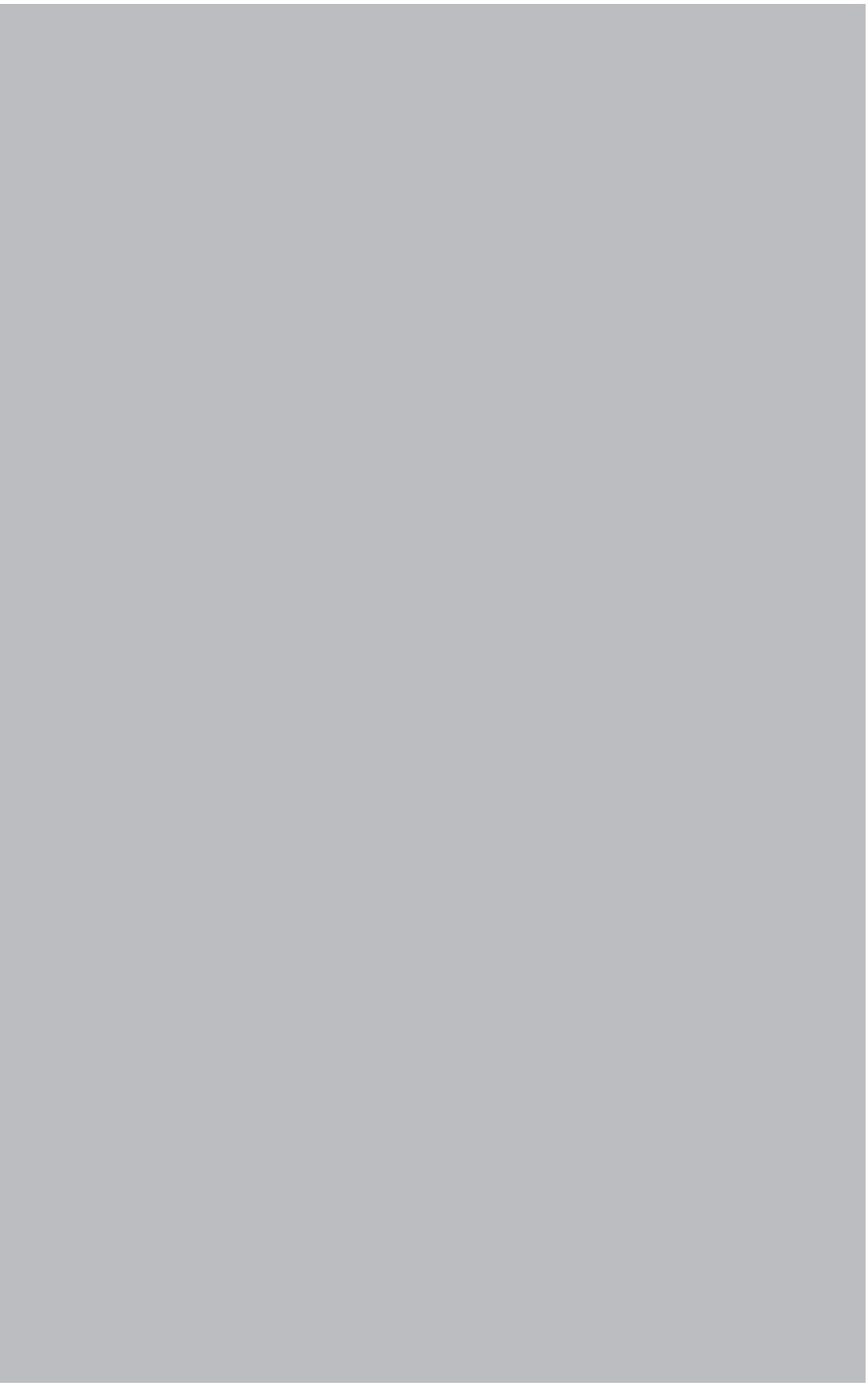
2-2 Three-month inspection 6-3
2-3 Six-month inspection 6-4
2-4 Three-year inspection 6-4

3. Replenishing grease to the linear guide 6-5

4. Replenishing grease to the ball screw 6-6



1. Before beginning work

Periodic inspection and maintenance are essential to ensure safe and efficient operation of YAMAHA robots. This chapter describes periodic inspection items and procedures for the NXY. Before beginning work, read the precautions below and also in Chapter 1 "Using the Robot Safely" and follow the instructions.

DANGER

IF THE INSPECTION OR MAINTENANCE PROCEDURE CALLS FOR OPERATION OF THE ROBOT, STAY OUT OF THE WORKING AREA OF THE ROBOT DURING OPERATION. DO NOT TOUCH ANY PARTS INSIDE THE CONTROLLER.
KEEP WATCHING THE ROBOT MOVEMENT AND SURROUNDING AREA SO THAT THE OPERATOR CAN PRESS THE EMERGENCY STOP BUTTON IF ANY DANGER OCCURS.

WARNING

- **WHEN THE ROBOT DOES NOT NEED TO BE OPERATED DURING ADJUSTMENT OR MAINTENANCE, ALWAYS TURN OFF THE CONTROLLER AND THE EXTERNAL SWITCH BOARD.**
- **DO NOT TOUCH INTERNAL PARTS OF THE CONTROLLER FOR 5 SECONDS AFTER THE CONTROLLER HAS BEEN TURNED OFF.**
- **WHEN ONLY MAKING ELECTRICAL INSPECTIONS AND REQUIRING NO MECHANICAL MOVEMENT OF THE ROBOT, KEEP THE EMERGENCY STOP BUTTON PRESSED.**
- **USE ONLY LUBRICANT AND GREASES SPECIFIED BY YAMAHA SALES OFFICE OR REPRESENTATIVE.**
- **USE ONLY PARTS SPECIFIED BY YAMAHA SALES OFFICE OR REPRESENTATIVE. TAKE SUFFICIENT CARE NOT TO ALLOW ANY FOREIGN MATTER TO CONTAMINATE THEM DURING ADJUSTMENT, PARTS REPLACEMENT OR REASSEMBLY.**
- **DO NOT MODIFY ANY PARTS ON THE ROBOT OR CONTROLLER. MODIFICATION MAY RESULT IN UNSATISFACTORY SPECIFICATIONS OR THREATEN OPERATOR SAFETY.**
- **WHEN ADJUSTMENT OR MAINTENANCE IS COMPLETE, RETIGHTEN THE BOLTS AND SCREWS SECURELY.**
- **DURING ROBOT ADJUSTMENT OR MAINTENANCE, PLACE A SIGN INDICATING THAT THE ROBOT IS BEING ADJUSTED OR SERVICED TO PREVENT OTHERS FROM TOUCHING THE CONTROL KEYS OR SWITCHES. PROVIDE A LOCK ON THE SWITCH KEYS OR ASK SOMEONE TO KEEP WATCH AS NEEDED.**

When applying grease to the ball screw and linear guide, take the following precautions.

WARNING

PRECAUTIONS WHEN HANDLING GREASE:

- **INFLAMMATION MAY OCCUR IF THIS GETS IN THE EYES. BEFORE HANDLING THE GREASE, WEAR YOUR SAFETY GOGGLES TO ENSURE THE GREASE WILL NOT COME IN CONTACT WITH THE EYES.**
- **INFLAMMATION MAY OCCUR IF THE GREASE COMES INTO CONTACT WITH SKIN. BE SURE TO WEAR PROTECTIVE GLOVES TO PREVENT CONTACT WITH SKIN.**
- **DO NOT TAKE ORALLY OR EAT. (EATING WILL CAUSE DIARRHEA AND VOMITING.)**
- **HANDS AND FINGERS MIGHT BE CUT WHEN OPENING THE GREASE CONTAINER, SO USE PROTECTIVE GLOVES.**
- **KEEP OUT OF THE REACH OF CHILDREN.**
- **DO NOT HEAT THE GREASE OR PLACE NEAR AN OPEN FLAME SINCE THIS COULD LEAD TO SPARKS AND FIRES.**

EMERGENCY TREATMENT:

- **IF GREASE GETS IN THE EYES, WASH LIBERALLY WITH PURE WATER FOR ABOUT 15 MINUTES AND CONSULT A PHYSICIAN FOR TREATMENT.**
- **IF GREASE COMES IN CONTACT WITH THE SKIN, WASH AWAY COMPLETELY WITH SOAP AND WATER.**
- **IF TAKEN INTERNALLY, DO NOT INDUCE VOMITING BUT PROMPTLY CONSULT A PHYSICIAN FOR PROPER TREATMENT.**

2. Periodic inspection

2-1 Daily inspection

Check the following points on a daily basis, before and after robot operation.

Checkpoints	Check items	Notes
Cables	Check for damage, dent and excessively tight bends.	Replace if needed.
Ball screw, bearing	Check for unusual vibration and noise.	
Motor	Check for unusual vibration and noise, and for abnormal temperature rise.	

2-2 Three-month inspection

Check the following points every 3 months and apply grease if needed.

Checkpoints	Check items	Notes
Ball screw, linear guide, ball bushing	• Check for dust buildup or debris. Clean if necessary. Apply grease after cleaning. • Check to see if the ball screw, linear guide and ball bushing are lubricated (not dry). Apply grease if necessary. Standard robots: Albania No. 2 (Shell) Daphne Eponex No. 2 (Idemitsu) Clean room robots: LG-2 (NSK)	See "4-3" in this chapter.

CAUTION

Using grease other than those recommended by YAMAHA might shorten the service life of the ball screw, linear guide and linear bushing shaft.

2-3 Six-month inspection

Check the following points every 6 months and adjust or replace parts if needed.

Checkpoints	Check items	Notes
Major bolts and screws on robot	Check for looseness. Tighten if loose.	
Ball screw, linear guide	• Check the ball screw and linear guide for backlash. Tighten if necessary. • Check for vibration during operation. Tighten bolts if necessary to secure drive unit and/or shaft. • Check for backlash due to wear.	Consult us if problem cannot be solved or there is backlash due to wear.
Controller	• Check if terminals are loose. • Check if connectors are loose	
Greasing to ball screw/ nut section and linear guide	Apply grease every 6 months to ball screw/nut and linear guide. Recommended grease Albania No. 2 (Shell) Daphne Eponex No. 2 (Idemitsu)	See "4-3" in this chapter.
Slider	On long-stroke robots, check the slider inside the top cover for wear or damage every 6 months.	

CAUTION

Using grease other than those recommended by YAMAHA might shorten the service life of the ball screw and linear guide.

2-4 Three-year inspection

Check the following points every 3 years or more often if the robot is used frequently.

Checkpoints	Check items	Notes
Ball screw/nut section and linear guide	Check ball screw/nut and linear guide for backlash due to wear.	Consult us if abnormal condition is found.

WARNING

- **ALWAYS TURN THE CONTROLLER POWER OFF BEFORE STARTING PERIODIC INSPECTIONS. SERIOUS ACCIDENTS COULD OCCUR IF THE ROBOT STARTS MOVING DURING THE PERIODIC INSPECTION.**
- **THE MOTOR AND SPEED REDUCTION GEAR CASING ARE EXTREMELY HOT AFTER AUTOMATIC OPERATION, SO BURNS MAY OCCUR IF THESE ARE TOUCHED. BEFORE HANDLING THESE PARTS, TURN OFF THE CONTROLLER, WAIT FOR A WHILE AND CHECK THAT THE PART HAS COOLED.**

3. Replenishing grease to the linear guide

Grease must be replenished to this linear guide periodically. Select the grease from the following recommended types.

Recommended grease : Alvania No. 2 (Showa Shell)
Daphne Eponex No. 2 (Idemitsu)

CAUTION

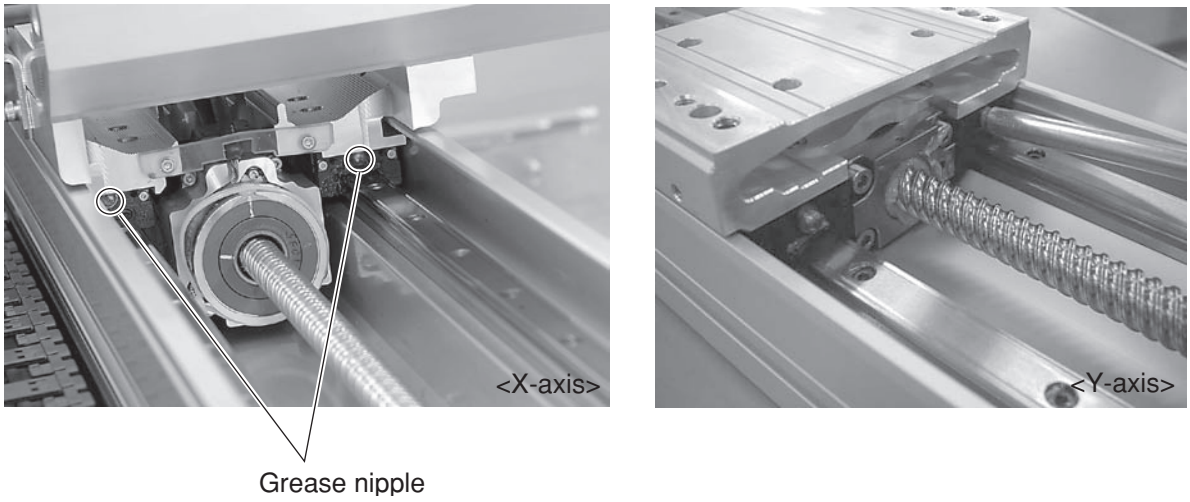
When designated by YAMAHA and the user, special grease, such as splatter-proof grease, may be applied when the robot is delivered. In this case, apply the appropriate grease as indicated in the delivery specification drawings, etc.

1) Turn the controller power OFF.
When the ZFL unit is attached for the 3rd-axis, the replenishment work can be carried out easier by moving the Z-axis slider to near the motor (near the origin) and turning the controller power OFF.

2) Place a sign indicating “Work In Progress” so that other operators do not turn the controller power ON.

3) Remove the axis stroke cover when replenishing grease. (Refer to section "2. Installation" for details on removing the X-axis cover.)

4) Using a grease gun, replenish grease from the grease nipple installed on the linear guide bearings. Sufficient grease has been replenished when new grease starts to seep out from the clearance between the linear guide bearings and rail.



X-axis, Y-axis

The X-axis and Y-axis each have four linear guide bearings. Replenish grease to all four bearings.

Wipe off any excessive grease that has seeped out to the rail.

Z-axis (ZFL)

Two linear guide bearings are attached. A grease nipple is attached to the counter-motor side of the slider, so move the slider to the motor side and then start the work.

5) Install the stroke cover.

6) Confirm the surrounding safety, and then turn the controller power ON.

4. Replenishing grease to the ball screw

The X-axis, Y-axis and Z-axis use a ball screw. Grease must be replenished to this ball screw periodically.

Recommended grease : Alvania No. 2 (Showa Shell)
Daphne Eponex No. 2 (Idemitsu)

CAUTION

- **When designated by YAMAHA and the user, special grease, such as splatter-proof grease, may be applied when the robot is delivered. In this case, apply the appropriate grease as indicated in the delivery specification drawings, etc.**
- **Always remove the grease nipple after completing the work. Damage or positional deviation could occur if the robot is operated with the grease nipple installed.**

1) Use the recommended grease nipple, A-M6X1(JIS B1575).

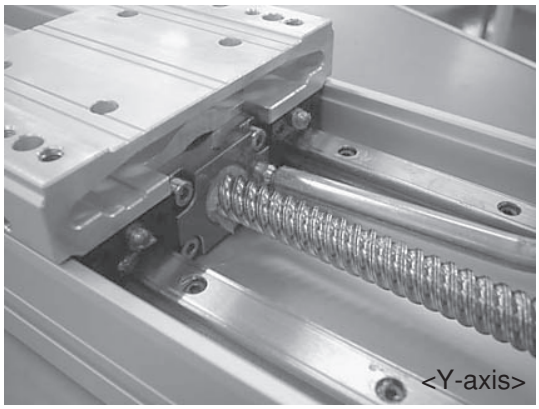
2) Turn the controller power OFF.
When the ZF unit is attached for the 3rd-axis, the replenishment work can be carried out easier by moving the Z-axis slider to near the motor (near the origin) and turning the controller power OFF.

3) Place a sign indicating “Work In Progress” so that other operators do not turn the controller power ON.

4) Remove the stroke cover of the axis to which grease is to be replenished. (Refer to section "1. Installation" for details on removing the X-axis cover.)

5) Install the grease nipple onto the ball screw flange.

6) Using a grease gun, replenish grease from the grease nipple.



Sufficient grease has been replenished when new grease starts to seep out from the clearance between the ball screw nut and screw. Wipe off any excessive grease.

Recommended grease	:	Alvania No. 2 (Showa Shell)
	:	Daphne Eponex No. 2 (Idemitsu)
Recommended grease gun	:	MG70 (THK N-type nozzle)

7) Remove the grease nipple.

Revision record

Manual version	Issue date	Description
Ver. 1.03	Jun. 2011	The manual's version number was changed to match that for the Japanese manual.
Ver. 1.04	Jun. 2011	The description regarding "Warranty" was changed.
Ver. 1.05	Oct. 2011	The cautions regarding wiring and piping were added.
Ver. 1.06	Jul. 2012	The description regarding "Warranty" was changed.

User's Manual

YAMAHA Cartesian Robot

XY-X series NXY

Jul. 2012
Ver. 1.06
This manual is based on Ver. 1.06 of Japanese manual.

YAMAHA MOTOR CO., LTD. IM Operations

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